US010974756B2

(12) **United States Patent**
Cana et al.

(10) **Patent No.: US 10,974,756 B2**
(45) **Date of Patent: Apr. 13, 2021**

(54) **CLUTCH DEVICE LATCHING SYSTEM AND METHOD**

(71) Applicant: **STEERING SOLUTIONS IP HOLDING CORPORATION**, Saginaw, MI (US)

(72) Inventors: **Edward A. Cana**, Grand Blanc, MI (US); **Keyur R. Patel**, Saginaw, MI (US)

(73) Assignee: **Steering Solutions IP Holding Corporation**, Saginaw, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 177 days.

(21) Appl. No.: **16/050,832**

(22) Filed: **Jul. 31, 2018**

(65) **Prior Publication Data**

US 2020/0039563 A1 Feb. 6, 2020

(51) **Int. Cl.**
B62D 1/184 (2006.01)
B62D 1/185 (2006.01)
B62D 1/183 (2006.01)

(52) **U.S. Cl.**
CPC ***B62D 1/184*** (2013.01); ***B62D 1/183*** (2013.01); ***B62D 1/185*** (2013.01)

(58) **Field of Classification Search**
CPC B62D 1/184; B62D 1/183; B62D 1/185; B62D 1/181
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

1,795,567 A 3/1931 Maurice
3,369,425 A 2/1968 Runkle et al.
3,386,309 A 6/1968 Reed et al.
3,396,600 A 8/1968 Zeigler et al.
3,782,492 A 1/1974 Hollins
4,138,167 A 2/1979 Ernst et al.
4,315,117 A 2/1982 Kokubo et al.
4,337,967 A 7/1982 Yoshida et al.
4,476,954 A 10/1984 Johnson et al.
4,503,300 A 3/1985 Lane, Jr.
4,503,504 A 3/1985 Suzumura et al.
4,509,386 A 4/1985 Kimberlin
4,535,645 A 8/1985 De Bisschop et al.
4,559,816 A 12/1985 Ebert et al.
4,561,323 A 12/1985 Stromberg
4,570,776 A 2/1986 Iwashita et al.
4,598,604 A 7/1986 Sorsche et al.
4,602,520 A 7/1986 Nishikawa et al.
4,633,732 A 1/1987 Nishikawa et al.
(Continued)

FOREIGN PATENT DOCUMENTS

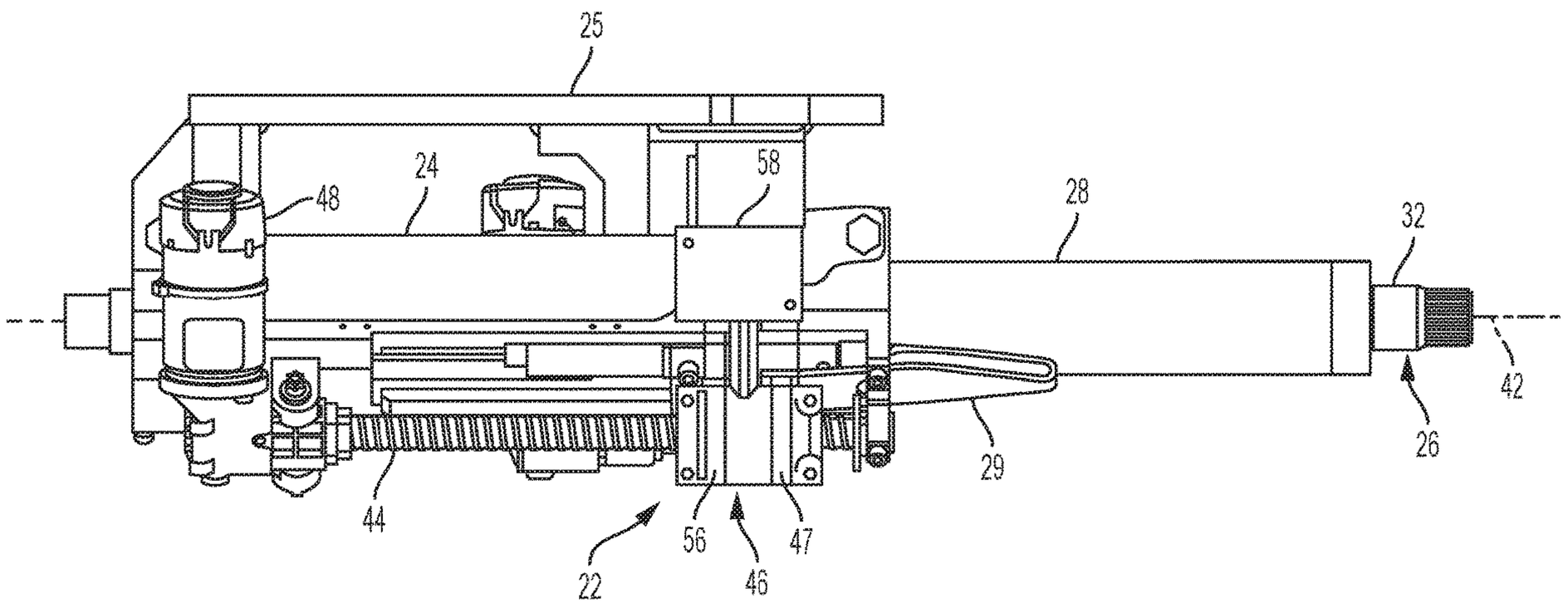
CN 1550395 A 12/2004
CN 1722030 A 1/2006
(Continued)

Primary Examiner — James A English
Assistant Examiner — Kurtis Nielson
(74) *Attorney, Agent, or Firm* — Dickinson Wright PLLC

(57) **ABSTRACT**

A retractable steering column assembly includes a retractable portion. Also included is an electric actuator mechanism for translating and/or tilting the retractable portion. Further included is a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion.

12 Claims, 5 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

4,661,752	A	4/1987	Nishikawa et al.	
4,669,325	A	6/1987	Nishikawa et al.	
4,691,587	A	9/1987	Farrand et al.	
4,785,684	A	11/1988	Nishikawa et al.	
4,811,580	A	3/1989	Jang	
4,836,566	A	6/1989	Birsching	
4,881,020	A	11/1989	Hida et al.	
4,893,518	A	1/1990	Matsumoto et al.	
4,901,544	A	2/1990	Jang	
4,901,593	A	2/1990	Ishikawa	
4,921,066	A	5/1990	Conley	
4,941,679	A	7/1990	Baumann et al.	
4,943,028	A	7/1990	Hoffmann et al.	
4,962,570	A	10/1990	Hosaka et al.	
4,967,618	A	11/1990	Matsumoto et al.	
4,976,239	A	12/1990	Hosaka	
5,048,364	A	9/1991	Minamoto et al.	
5,226,853	A	7/1993	Courgeon	
5,240,284	A	8/1993	Takada et al.	
5,295,712	A	3/1994	Omura	
5,311,432	A	5/1994	Momose	
5,319,803	A	6/1994	Allen	
5,428,873	A	7/1995	Hitchcock et al.	
5,488,555	A	1/1996	Asgari et al.	
5,590,565	A	1/1997	Palfenier et al.	
5,606,892	A	3/1997	Hedderly	
5,613,404	A	3/1997	Lykken et al.	
5,618,058	A	4/1997	Byon	
5,668,721	A	9/1997	Chandy	
5,678,454	A	10/1997	Cartwright et al.	
5,690,362	A	11/1997	Peitsmeier et al.	
5,737,971	A	4/1998	Riefe et al.	
5,765,116	A	6/1998	Wilson-Jones et al.	
5,813,699	A	9/1998	Donner et al.	
5,890,397	A	4/1999	Stoner et al.	
5,893,580	A	4/1999	Hoagland et al.	
5,911,789	A	6/1999	Keipert et al.	
5,931,250	A	8/1999	Kagawa et al.	
5,941,130	A	8/1999	Olgren et al.	
6,041,677	A	3/2000	Reh et al.	
6,070,686	A	6/2000	Pollmann	
6,079,513	A	6/2000	Nishizaki et al.	
6,142,523	A	11/2000	Bathis et al.	
6,220,630	B1	4/2001	Sundholm et al.	
6,227,571	B1	5/2001	Sheng et al.	
6,234,040	B1	5/2001	Weber et al.	
6,264,239	B1	7/2001	Link	
6,301,534	B1	10/2001	McDermott, Jr. et al.	
6,343,993	B1	2/2002	Duval et al.	
6,354,622	B1	3/2002	Ulbrich et al.	
6,354,626	B1	3/2002	Cartwright	
6,360,149	B1	3/2002	Kwon et al.	
6,373,472	B1	4/2002	Palalau et al.	
6,381,526	B1	4/2002	Higashi et al.	
6,390,505	B1	5/2002	Wilson	
6,460,427	B1	10/2002	Hedderly	
6,571,587	B2	6/2003	Dimig et al.	
6,578,449	B1	6/2003	Anspaugh et al.	
6,611,745	B1	8/2003	Paul	
6,612,198	B2	9/2003	Rouleau et al.	
6,612,393	B2	9/2003	Bohner et al.	
6,819,990	B2	11/2004	Ichinose	
7,021,416	B2	4/2006	Kapaan et al.	
7,025,380	B2	4/2006	Arihara	
7,048,305	B2	5/2006	Muller	
7,062,365	B1	6/2006	Fei	
7,140,213	B2	11/2006	Feucht et al.	
7,159,904	B2	1/2007	Schafer et al.	
7,213,842	B2	5/2007	Uehle et al.	
7,258,365	B2	8/2007	Kahlenberg et al.	
7,261,014	B2	8/2007	Arihara	
7,290,800	B2	11/2007	Schwarzbich et al.	
7,295,904	B2	11/2007	Kanevsky et al.	
7,308,964	B2	12/2007	Hara et al.	
7,410,190	B2 *	8/2008	Sawada	B62D 1/19 180/427
7,428,944	B2	9/2008	Gerum	
7,461,863	B2	12/2008	Muller	
7,495,584	B1	2/2009	Sorensen	
7,533,594	B2	5/2009	Menjak et al.	
7,628,244	B2	12/2009	Chino et al.	
7,719,431	B2	5/2010	Bolourchi	
7,735,405	B2	6/2010	Parks	
7,758,073	B1	7/2010	Chou	
7,775,129	B2	8/2010	Oike et al.	
7,784,830	B2	8/2010	Ulintz	
7,793,980	B2	9/2010	Fong	
7,862,079	B2	1/2011	Fukawatase et al.	
7,975,569	B2	1/2011	Klos	
7,894,951	B2	2/2011	Norris et al.	
7,909,361	B2	3/2011	Oblizajek et al.	
7,913,803	B2	3/2011	Hidaka	
8,002,075	B2	8/2011	Markfort	
3,021,235	A1	9/2011	Tinnin et al.	
8,011,265	B2	9/2011	Menjak et al.	
8,027,767	B2	9/2011	Klein et al.	
8,055,409	B2	11/2011	Tsuchiya	
8,069,745	B2	12/2011	Strieter et al.	
8,079,312	B2	12/2011	Long	
8,146,945	B2	4/2012	Born et al.	
8,161,839	B2	4/2012	Warashina	
8,170,725	B2	5/2012	Chin et al.	
8,260,482	B1	9/2012	Szybalski et al.	
8,352,110	B1	1/2013	Szybalski et al.	
8,466,382	B2	6/2013	Donicke	
8,479,605	B2	7/2013	Shavrnoch et al.	
8,548,667	B2	10/2013	Kaufmann	
8,606,455	B2	12/2013	Boehringer et al.	
8,634,980	B1	1/2014	Urmson et al.	
8,650,982	B2	2/2014	Matsuno et al.	
8,670,891	B1	3/2014	Szybalski et al.	
8,695,750	B1	4/2014	Hammond et al.	
8,733,201	B2	5/2014	Okano et al.	
8,818,608	B2	8/2014	Cullinane et al.	
8,825,258	B2	9/2014	Cullinane et al.	
8,825,261	B1	9/2014	Szybalski et al.	
8,843,268	B2	9/2014	Lathrop et al.	
8,874,301	B1	10/2014	Rao et al.	
8,880,287	B2	11/2014	Lee et al.	
8,881,861	B2	11/2014	Tojo	
8,899,623	B2	12/2014	Stadler et al.	
8,909,428	B1	12/2014	Lombrozo	
8,948,993	B2	2/2015	Schulman et al.	
8,950,543	B2	2/2015	Heo et al.	
8,955,407	B2	2/2015	Sakuma	
8,979,126	B2 *	3/2015	Morinaga	B62D 1/181 280/775
8,994,521	B2	3/2015	Gazit	
9,002,563	B2	4/2015	Green et al.	
9,031,729	B2	5/2015	Lathrop et al.	
9,032,835	B2	5/2015	Davies et al.	
9,039,041	B2	5/2015	Buzzard et al.	
9,045,078	B2	6/2015	Tovar et al.	
9,073,574	B2	7/2015	Cuddihy et al.	
9,080,895	B2	7/2015	Martin et al.	
9,092,093	B2	7/2015	Jubner et al.	
9,108,584	B2	8/2015	Rao et al.	
9,134,729	B1	9/2015	Szybalski et al.	
9,150,200	B2	10/2015	Urhahne	
9,150,224	B2	10/2015	Yopp	
9,164,619	B2	10/2015	Goodlein	
9,174,642	B2	11/2015	Wimmer et al.	
9,186,994	B2	11/2015	Okuyama et al.	
9,193,375	B2	11/2015	Schramm et al.	
9,199,553	B2	12/2015	Cuddihy et al.	
9,227,531	B2	1/2016	Cuddihy et al.	
9,233,638	B2	1/2016	Lisseman et al.	
9,235,211	B2	1/2016	Davidsson et al.	
9,235,987	B2	1/2016	Green et al.	
9,238,409	B2	1/2016	Lathrop et al.	
9,248,743	B2	2/2016	Enthaler et al.	
9,260,130	B2	2/2016	Mizuno	
9,290,174	B1	3/2016	Zagorski	

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,290,201	B1	3/2016	Lombrozo	
9,296,410	B2	3/2016	Isogai et al.	
9,298,184	B2	3/2016	Bartels et al.	
9,308,857	B2	4/2016	Lisseman et al.	
9,308,891	B2	4/2016	Cudak et al.	
9,333,983	B2	5/2016	Lathrop et al.	
9,352,752	B2	5/2016	Cullinane et al.	
9,360,108	B2	6/2016	Pfenninger et al.	
9,360,865	B2	6/2016	Yopp	
9,421,994	B2	8/2016	Agbor et al.	
9,487,228	B2	11/2016	Febre et al.	
9,550,514	B2	1/2017	Schulz et al.	
9,616,914	B2	4/2017	Stinebring et al.	
9,643,641	B1	5/2017	Stinebring et al.	
9,663,136	B2	5/2017	Stinebring et al.	
9,744,983	B2	8/2017	Stinebring et al.	
9,828,016	B2	11/2017	Lubischer	
9,845,106	B2	12/2017	Bodtker	
9,849,904	B2	12/2017	Rouleau	
9,862,403	B1	1/2018	Rouleau et al.	
9,919,724	B2	3/2018	Lubischer et al.	
10,065,655	B2	9/2018	Bendewald et al.	
10,189,496	B2 *	1/2019	King	B62D 1/184
2002/0171235	A1	11/2002	Riefe et al.	
2003/0046012	A1	3/2003	Yamaguchi	
2003/0146037	A1	8/2003	Menjak et al.	
2003/0183440	A1	10/2003	Thomas et al.	
2003/0188598	A1	10/2003	Cartwright	
2003/0227159	A1	12/2003	Muller	
2004/0016588	A1	1/2004	Vitale et al.	
2004/0046346	A1	3/2004	Eki et al.	
2004/0046379	A1	3/2004	Riefe	
2004/0099083	A1	5/2004	Choi et al.	
2004/0099468	A1	5/2004	Chernoff et al.	
2004/0129098	A1	7/2004	Gayer et al.	
2004/0204808	A1	10/2004	Satoh et al.	
2004/0262063	A1	12/2004	Kaufmann et al.	
2005/0001445	A1	1/2005	Ercolano	
2005/0081675	A1	4/2005	Oshita et al.	
2005/0197746	A1	9/2005	Pelchen et al.	
2005/0242562	A1	11/2005	Ridgway et al.	
2005/0263996	A1	12/2005	Manwaring et al.	
2005/0275205	A1	12/2005	Ahnafield	
2006/0005658	A1	1/2006	Armstrong et al.	
2006/0186658	A1	8/2006	Yasuhara et al.	
2006/0202463	A1	9/2006	Schwarzbich et al.	
2006/0219499	A1	10/2006	Organek	
2006/0224287	A1	10/2006	Izawa et al.	
2006/0230863	A1 *	10/2006	Rouleau	B62D 1/184 74/492
2006/0237959	A1	10/2006	Dimig et al.	
2006/0244251	A1	11/2006	Muller	
2006/0283281	A1	12/2006	Li et al.	
2007/0021889	A1	1/2007	Tsuchiya	
2007/0029771	A1	2/2007	Haglund et al.	
2007/0046003	A1	3/2007	Mori et al.	
2007/0046013	A1	3/2007	Bito et al.	
2007/0096446	A1	5/2007	Breed	
2007/0126222	A1	6/2007	Koya et al.	
2007/0158116	A1	7/2007	Peppler	
2007/0241548	A1	10/2007	Fong	
2007/0284867	A1	12/2007	Cymbal et al.	
2008/0009986	A1	1/2008	Lu et al.	
2008/0028884	A1	2/2008	Monash	
2008/0047382	A1	2/2008	Tomaru et al.	
2008/0079253	A1	4/2008	Sekii et al.	
2008/0147276	A1	6/2008	Pattok et al.	
2008/0216597	A1	9/2008	Iwakawa et al.	
2008/0238068	A1 *	10/2008	Kumar	B62D 1/183 280/775
2008/0264196	A1	10/2008	Schindler et al.	
2009/0024278	A1	1/2009	Kondo et al.	
2009/0056493	A1	3/2009	Dubay et al.	
2009/0107284	A1	4/2009	Lucas et al.	
2009/0229400	A1	9/2009	Ozsoylu et al.	
2009/0256342	A1	10/2009	Cymbal et al.	
2009/0266195	A1 *	10/2009	Tanke	B62D 1/184 74/493
2009/0276111	A1	11/2009	Wang et al.	
2009/0280914	A1	11/2009	Kakutani et al.	
2009/0292466	A1	11/2009	McCarthy et al.	
2010/0152952	A1	6/2010	Lee et al.	
2010/0218637	A1	9/2010	Barroso	
2010/0222976	A1	9/2010	Haug	
2010/0228417	A1	9/2010	Lee et al.	
2010/0228438	A1	9/2010	Buerkle	
2010/0280713	A1	11/2010	Stahlin et al.	
2010/0286869	A1	11/2010	Katch et al.	
2010/0288567	A1	11/2010	Bonne	
2011/0098922	A1	4/2011	Ibrahim	
2011/0153160	A1	6/2011	Hesseling et al.	
2011/0167940	A1	7/2011	Shavrnoch et al.	
2011/0167948	A1 *	7/2011	Andrearczyk	B62D 1/181 74/493
2011/0187518	A1	8/2011	Strumolo et al.	
2011/0266396	A1	11/2011	Abildgaard et al.	
2011/0282550	A1	11/2011	Tada et al.	
2011/0314954	A1	12/2011	Matsuno et al.	
2012/0136540	A1	5/2012	Miller	
2012/0174695	A1 *	7/2012	Bertet	B62D 1/184 74/493
2012/0205183	A1	8/2012	Rombold	
2012/0209473	A1	8/2012	Birsching et al.	
2012/0215377	A1	8/2012	Takemura et al.	
2012/0247259	A1 *	10/2012	Mizuno	B62D 1/181 74/493
2012/0287050	A1	11/2012	Wu	
2013/0002416	A1	1/2013	Gazit	
2013/0325202	A1	1/2013	Howard et al.	
2013/0087006	A1	4/2013	Ohtsubo et al.	
2013/0104689	A1	5/2013	Marutani et al.	
2013/0133463	A1	5/2013	Moriyama	
2013/0158771	A1	6/2013	Kaufmann	
2013/0174686	A1	7/2013	Hirche et al.	
2013/0199866	A1	8/2013	Yamamoto et al.	
2013/0205933	A1	8/2013	Moriyama	
2013/0218396	A1	8/2013	Moshchuk et al.	
2013/0233117	A1	9/2013	Read et al.	
2013/0292955	A1	11/2013	Higgins et al.	
2013/0325264	A1	12/2013	Alcazar et al.	
2014/0028008	A1	1/2014	Stadler et al.	
2014/0046542	A1	2/2014	Kauffman et al.	
2014/0046547	A1	2/2014	Kauffman et al.	
2014/0111324	A1	4/2014	Lisseman et al.	
2014/0116187	A1	5/2014	Tinnin	
2014/0137694	A1	5/2014	Sugiura	
2014/0277896	A1	9/2014	Lathrop et al.	
2014/0300479	A1	10/2014	Wolter et al.	
2014/0309816	A1	10/2014	Stefan et al.	
2015/0002404	A1	1/2015	Hooton	
2015/0014086	A1	1/2015	Eisenbarth	
2015/0032322	A1	1/2015	Wimmer et al.	
2015/0051780	A1	1/2015	Hahne	
2015/0120142	A1	1/2015	Park et al.	
2015/0210273	A1	2/2015	Kaufmann et al.	
2015/0060185	A1	3/2015	Feguri	
2015/0246673	A1	4/2015	Tseng et al.	
2015/0137492	A1	5/2015	Rao et al.	
2015/0203145	A1	7/2015	Sugiura et al.	
2015/0203149	A1	7/2015	Katayama et al.	
2015/0251666	A1	7/2015	Attard et al.	
2015/0324111	A1	9/2015	Jubner et al.	
2015/0283998	A1	10/2015	Lind et al.	
2015/0375769	A1	12/2015	Abboud et al.	
2016/0009332	A1	1/2016	Sirbu	
2016/0016604	A1	1/2016	Johta et al.	
2016/0075371	A1	3/2016	Varunjikar et al.	
2016/0082867	A1	3/2016	Sugioka et al.	
2016/0200246	A1	3/2016	Lisseman et al.	
2016/0114828	A1	4/2016	Tanaka et al.	
2016/0185387	A1	6/2016	Kuoch	
2016/0200343	A1	6/2016	Lisseman et al.	
2016/0200344	A1	7/2016	Sugioka et al.	
2016/0207538	A1	7/2016	Urano et al.	

(56) **References Cited**

U.S. PATENT DOCUMENTS

2016/0209841	A1	7/2016	Yamaoka et al.	
2016/0229450	A1	7/2016	Basting et al.	
2016/0231743	A1	7/2016	Bendewald et al.	
2016/0244070	A1*	8/2016	Bendewald	B62D 1/28
2016/0244086	A1	8/2016	Moriyama	
2016/0252133	A1	9/2016	Caverly	
2016/0318540	A1	11/2016	King	
2016/0318542	A1	11/2016	Pattok et al.	
2016/0347347	A1	12/2016	Lubischer et al.	
2016/0347348	A1	12/2016	Lubischer et al.	
2016/0362084	A1	12/2016	Martin et al.	
2016/0362117	A1	12/2016	Kaufmann et al.	
2016/0362126	A1*	12/2016	Lubischer	B62D 1/183
2016/0368522	A1	12/2016	Lubischer	
2016/0375770	A1	12/2016	Ryne et al.	
2016/0375860	A1	12/2016	Lubischer	
2016/0375923	A1	12/2016	Schulz	
2016/0375924	A1	12/2016	Bodtker et al.	
2016/0375925	A1	12/2016	Lubischer et al.	
2016/0375926	A1	12/2016	Lubischer et al.	
2016/0375927	A1	12/2016	Schulz et al.	
2016/0375928	A1	12/2016	Magnus	
2016/0375929	A1	12/2016	Rouleau	
2016/0375931	A1	12/2016	Lubischer et al.	
2017/0029009	A1	2/2017	Rouleau	
2017/0029018	A1	2/2017	Lubischer et al.	
2017/0057535	A1*	3/2017	Vermeersch	B62D 1/184
2017/0097071	A1	4/2017	Galehr	
2017/0106894	A1	4/2017	Bodtker	
2017/0106895	A1	4/2017	Jager et al.	
2017/0113589	A1	4/2017	Riefe	
2017/0113712	A1	4/2017	Watz	
2017/0151975	A1	7/2017	Schmidt et al.	
2017/0294120	A1	10/2017	Ootsuji	
2017/0297606	A1	10/2017	Kim et al.	
2017/0341677	A1	11/2017	Buzzard et al.	
2017/0361863	A1	12/2017	Rouleau	
2017/0369091	A1*	12/2017	Nash	B62D 1/183
2018/0029628	A1	2/2018	Sugishita	
2018/0029640	A1	2/2018	Otto et al.	
2018/0050720	A1	2/2018	King et al.	
2018/0072339	A1	3/2018	Bodtker	
2018/0079441	A1	3/2018	McKinzie et al.	
2018/0086378	A1	3/2018	Bell et al.	
2018/0111639	A1	4/2018	Bodtker et al.	
2018/0148084	A1	5/2018	Nash et al.	
2018/0154932	A1	6/2018	Rakouth et al.	
2018/0229753	A1	8/2018	Magnus et al.	
2018/0238400	A1	8/2018	Magnus et al.	
2018/0251147	A1	9/2018	Heitz et al.	
2018/0273081	A1	9/2018	Lubischer et al.	

FOREIGN PATENT DOCUMENTS

CN	1736786	A	2/2006
CN	101037117	A	9/2007
CN	101041355	A	9/2007
CN	101049814	A	10/2007
CN	101291840	A	10/2008
CN	101402320	A	4/2009
CN	101596903	A	12/2009
CN	201534560	U	7/2010
CN	101954862	A	1/2011
CN	102161346	A	8/2011
CN	102452391	A	5/2012
CN	102523738	A	6/2012
CN	102574545	B	7/2012
CN	202337282	U	7/2012
CN	102806937	A	12/2012
CN	103085854	A	5/2013
CN	103419840	A	12/2013
CN	103587571	A	2/2014
CN	203793405	U	8/2014
CN	204222957	U	3/2015
DE	4310431	A1	10/1994
DE	19954505	A1	5/2001
DE	10212782	A1	10/2003
DE	102005032528	A1	1/2007
DE	102005056438	A1	6/2007
DE	102006025254	A1	12/2007
DE	102008057313	A1	10/2009
DE	102010025197	A1	12/2011
DE	102013110865	A1	4/2015
DE	102015216326	B4	9/2016
EP	1559630	A2	8/2005
EP	1783719	A2	5/2007
EP	2426030	A1	3/2012
EP	2489577	A2	8/2012
EP	1606149	B1	5/2014
FR	2862595	A1	5/2005
FR	3016327	A1	7/2015
JP	S58191668A	A	11/1983
JP	60164629	A	8/1985
JP	S60157963	A	8/1985
JP	H05162652	A	6/1993
JP	2007253809	A	10/2007
JP	2012201334	A	10/2012
KR	101062339	B1	9/2011
WO	2006099483	A1	9/2006
WO	2010082394	A1	7/2010
WO	2010116518	A1	10/2010
WO	2014208573	A1	12/2014

* cited by examiner

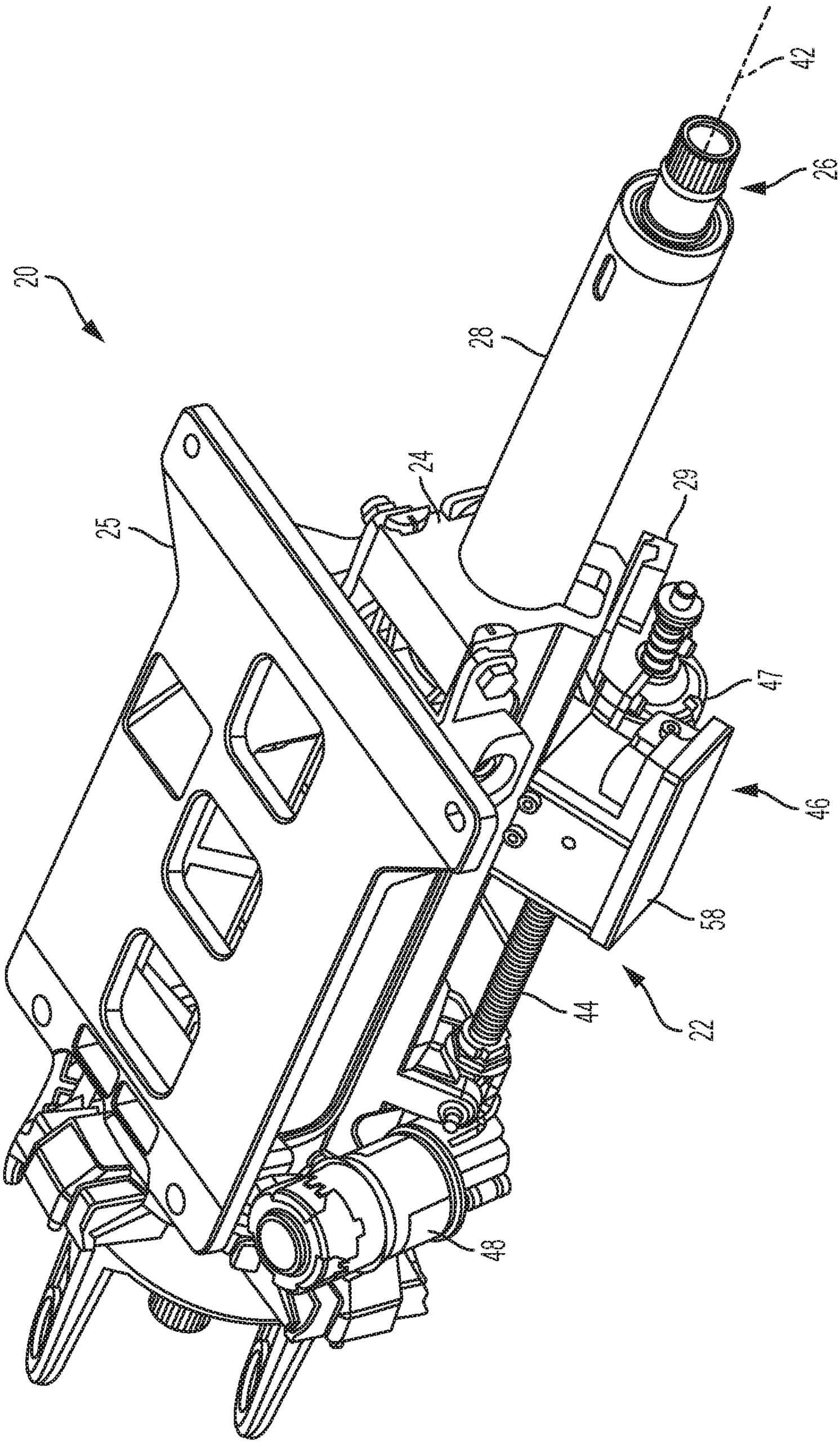


FIG. 1

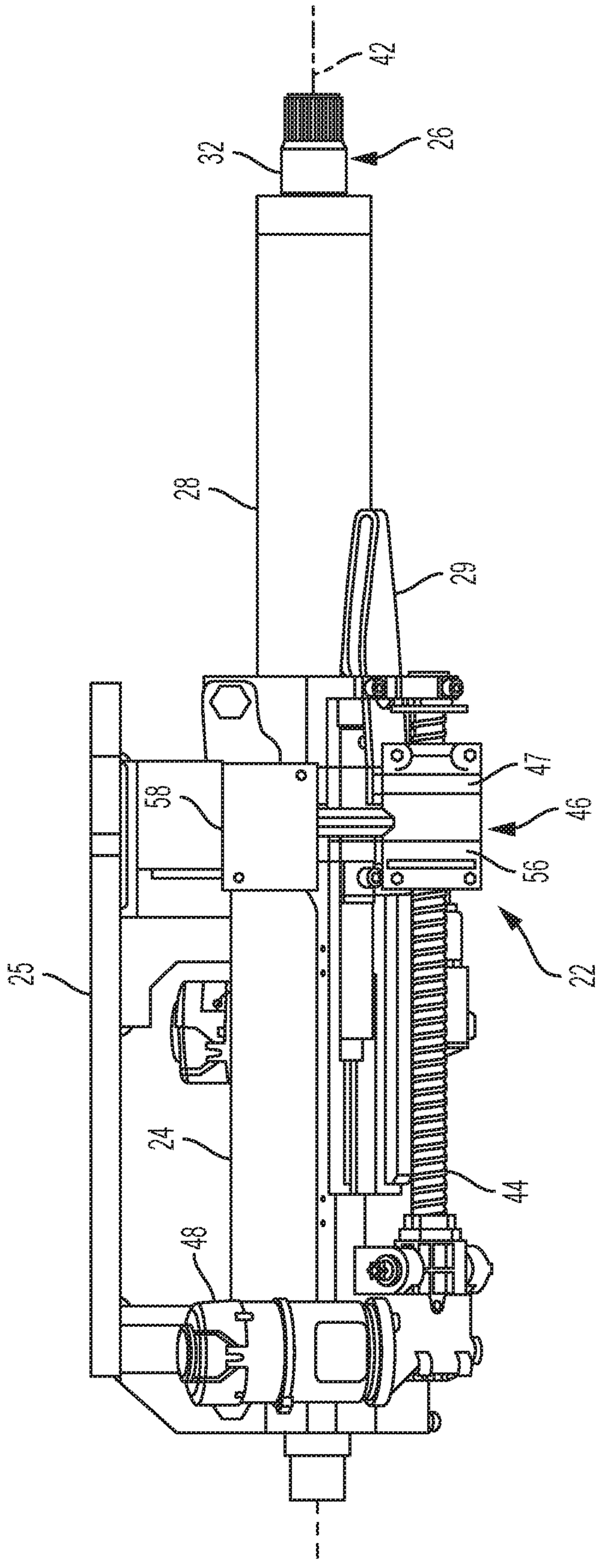


FIG. 2

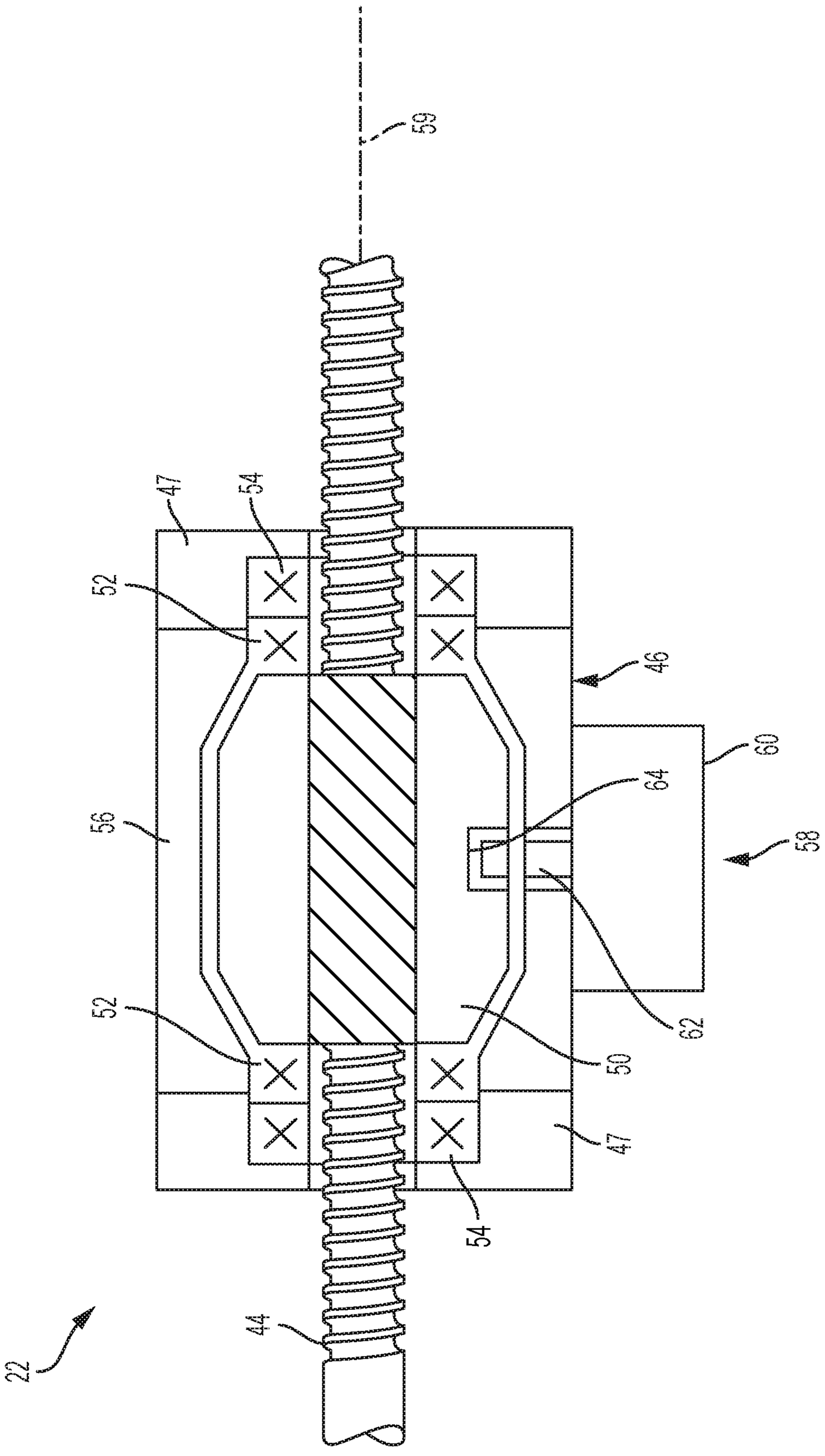


FIG. 3

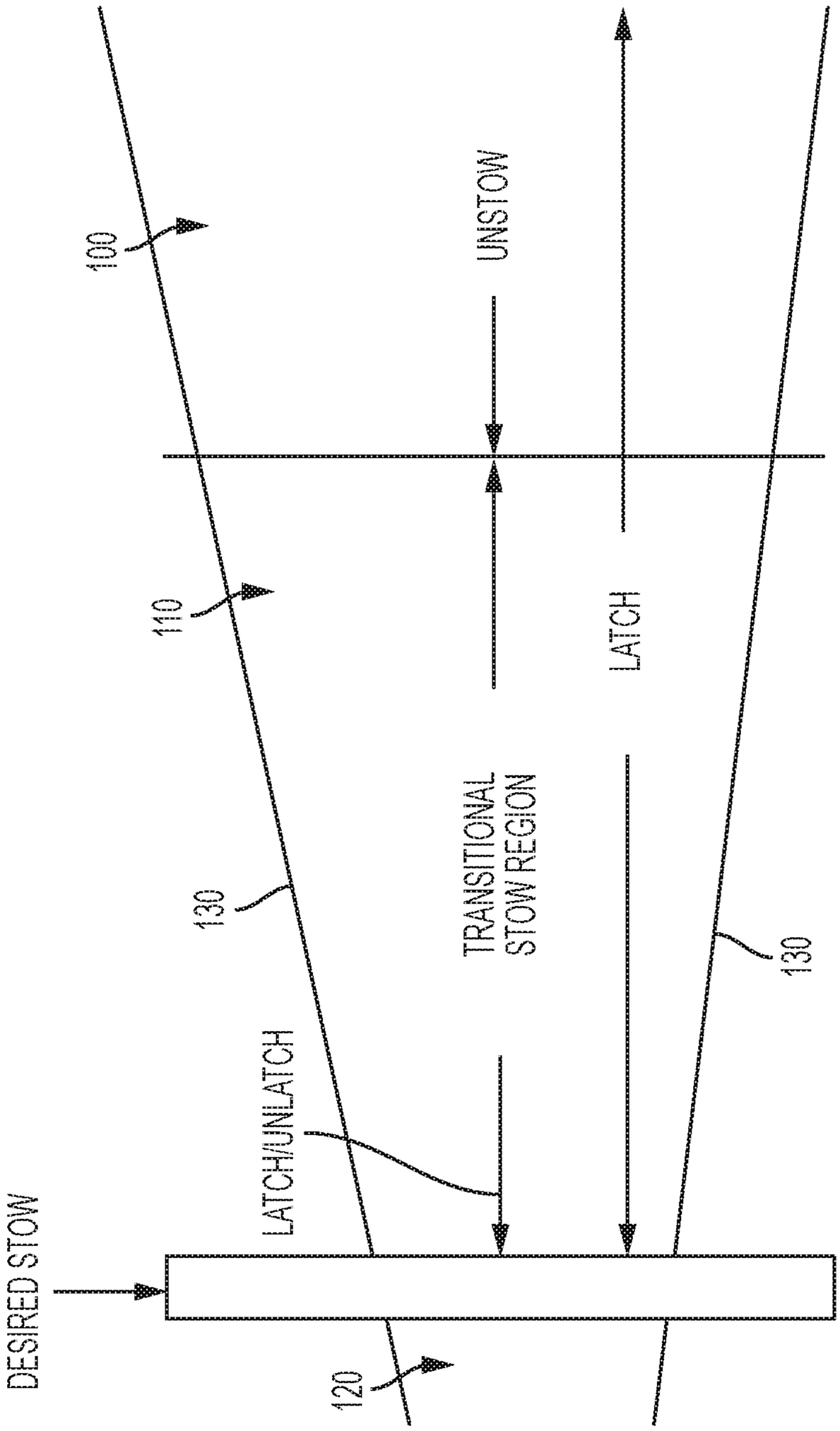

DESIRED STOW
LATCH/UNLATCH
UNSTOW
LATCH
TRANSITIONAL STOW REGION
100
110
120
130
130

FIG. 4

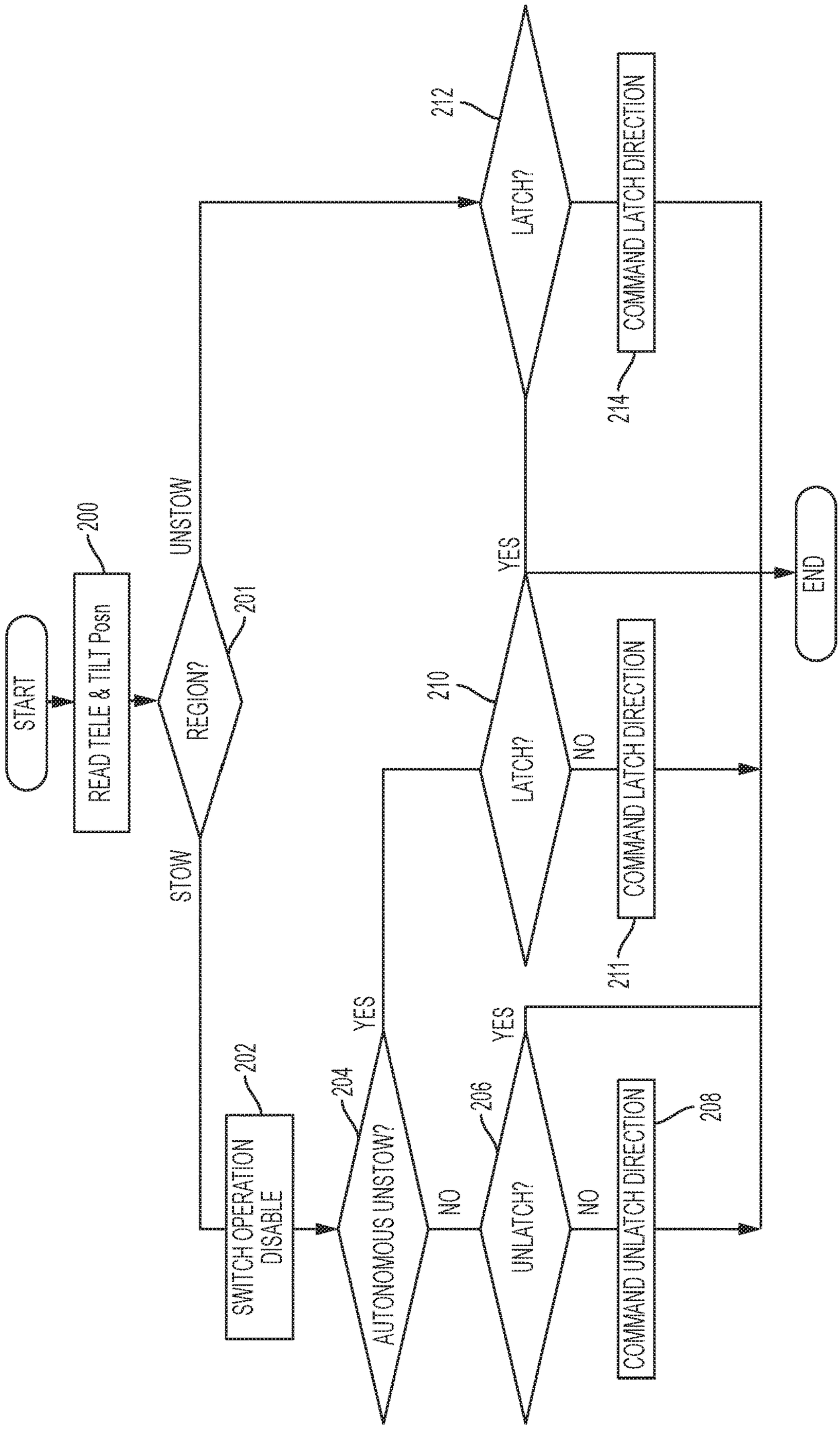

START
200
READ TELE & TILT Posn
201
REGION?
STOW
UNSTOW
202
SWITCH OPERATION DISABLE
204
AUTONOMOUS UNSTOW?
NO
YES
206
UNLATCH?
NO
YES
208
COMMAND UNLATCH DIRECTION
210
LATCH?
NO
YES
211
COMMAND LATCH DIRECTION
212
LATCH?
YES
214
COMMAND LATCH DIRECTION
END

FIG. 5

CLUTCH DEVICE LATCHING SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

The embodiments described herein relate to retracting steering column assemblies and, more particularly, to a system and method associated with a clutch device latching system.

As autonomously driven vehicles are developed, a number of opportunities will evolve related to comfort, entertainment and functionality for drivers. Steering wheels are commonly limited to standard driving positions due to the need for a driver to handle the steering wheel during operation of the vehicle. These limitations may be unnecessary during an autonomous driving mode of a vehicle. For example, a steering wheel may be retracted to a stowed position to enlarge the space available for a driver.

An automated, electromechanical system is often relied upon to translate the steering column between an extended position and a retracted position. Some systems also allow manual adjustment of the steering column, but a clutch device and nut in a power column currently require a driver to wait until the column extends away from a retracted (also referred to as stowed) position before manual adjustment is available.

SUMMARY OF THE INVENTION

According to an aspect of the disclosure, a retractable steering column assembly includes a retractable portion. Also included is an electric actuator mechanism for translating and/or tilting the retractable portion. Further included is a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion.

According to another aspect of the disclosure, a method of controlling adjustment of a steering column assembly is provided. The method includes detecting a position of the steering column assembly. The method also includes determining which one of a plurality of regions the telescope position is within. The method further includes unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions. The method yet further includes latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions.

These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The subject matter which is regarded as the invention is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

FIG. **1** is a perspective view of a steering column assembly;

FIG. **2** is an elevational view of the steering column assembly;

FIG. **3** is a sectional view of a portion of the steering column assembly;

FIG. **4** is a diagram illustrating multiple regions associated with stowed and unstowed positions of the steering column assembly; and

FIG. **5** is a flow diagram illustrating a method of controlling the steering column assembly.

DETAILED DESCRIPTION

Referring now to the Figures, where the invention will be described with reference to specific embodiments, without limiting same, FIG. **1** illustrates a steering column assembly **20**. The steering column assembly **20** facilitates translation of a steering wheel (not shown) and a steering shaft **26** in a retractable manner. This is particularly beneficial in embodiments where the assembly **20** is employed in a passenger vehicle equipped with Advanced Driver Assist System(s) (ADAS) to allow the vehicle to be autonomously, or semi-autonomously, controlled using sensing, steering, and/or braking technology. When the ADAS is activated, the steering wheel is not required for vehicle control in some situations. Retraction of the steering wheel and steering shaft **26** toward, and possibly into, the instrument cluster greatly enhances user comfort by providing a driver with more space. The additional space provided facilitates additional workspace area or leg room, for example.

The embodiments described herein provide a retractable steering column which allows the steering wheel to be retracted while the vehicle is in an autonomous, or semi-autonomous, driving mode, and methods associated with monitoring and adjusting the steering column assembly **20**. The operating conditions described herein for the steering wheel are standard driving mode, autonomous driving mode, and a transition mode therebetween.

In the standard driving mode, the steering column assembly **20** is extended to a location that disposes the steering wheel in a position that is comfortably reached by a driver in a manner that allows the driver to fully handle and control the steering wheel. The transition mode is defined by movement of the steering column assembly **20** during transitioning of the assembly between the standard and autonomous driving modes. An electric actuator mechanism **48** at least partially retracts the steering column assembly **20** into the instrument cluster of the vehicle during the transition mode. When the driver wants to transition back to the standard driving mode, the ADAS is deactivated and the electric actuator mechanism **48** extends the steering column assembly **20** to an extended position that allows the driver to easily handle the steering wheel. However, the embodiments described herein allow manual adjustment under certain circumstances, as described herein.

Extension and retraction of the steering column assembly **20** refers to translation of a retractable portion **28** of the steering column assembly **20**. The retractable portion **28** includes one or more components that are translatable. For example, in addition to the aforementioned steering wheel and the steering shaft **26**, a moveable portion, which may also be referred to as an upper jacket **28** in some embodiments, is translatable relative to a stationary portion **24**, which may be referred to as a lower jacket in some embodiments. Also shown is a mounting bracket **25** that couples the steering column assembly **20** to the vehicle.

The electric actuator mechanism **48** is operatively coupled to the moveable portion **28** and the stationary portion **24** of the steering column assembly **20**. A translating assembly facilitates automated telescoping (i.e., translating) and rak-

ing (i.e., tilting) of the steering column assembly. Several embodiments of translating assemblies are contemplated.

FIGS. **2** and **3** illustrate an embodiment of features of a translating assembly that facilitate adjustment of the steering column assembly **20**. Multiple embodiments of a clutch device and nut are described in detail in U.S. patent application Ser. No. 15/628,836, which is incorporated by reference herein its entirety. FIGS. **2** and **3** illustrate an example of such features, but it is to be appreciated that the embodiments described herein are applicable to any powered steering column that allows manual adjustment thereof in some conditions, with such conditions defined herein.

FIGS. **2** and **3** illustrate a screw or threaded rod **44**, a shuttle assembly **46**, and a drive means **48** (e.g., electric motor, see FIG. **1**). The shuttle assembly **46** may include a shuttle **47** and a clutch device **58** that may be directly supported by and engaged to the shuttle **47**, or a casing **56** of the shuttle **47**.

The shuttle **47** of the shuttle assembly **46** may be mounted between the screw **44** and an E/A strap **29**. More specifically, the shuttle assembly **46** is threadably mounted to the screw **44** for axial translation along the screw, and may be rigidly fixed to the E/A strap **29**. In operation and when the electric motor **48** is rotating the screw **44**, the shuttle assembly **46** axially translates along the rotating screw **44**. During this axial translation, the rearward shaft portion **32** of the steering shaft **26** and the upper jacket **28** is carried by, and with, the shuttle assembly **46**.

The shuttle assembly **46** may further include a nut or fixture **50**, at least one bearing **52**, at least one resilient member **54** (e.g., a coiled spring or a disc spring), and the casing **56**. The screw **44** may be mounted for rotation to the lower jacket **24** and about a centerline **59**, may not be mounted for axial translation along the lower jacket **24**, and is rotatably driven by the electric motor **48** that may be rigidly mounted to the fixed lower jacket **24**. The centerline **59** may be spaced from, and substantially parallel to, the axis **42**.

The clutch device **58** may be mounted to the casing **56** and facilitates rotational decoupling of the nut **50** from the casing **56** (and/or shuttle **47**). The clutch device **58** may include an electric servo **60** and a bolt **62**. The servo **60** may be mounted to an exterior of the casing **56** and functions to move the bolt **62** into and out of at least one recess **64** defined by an external and circumferentially continuous surface of the nut **50**. In one example, the recesses **64** may be axially extending grooves. The clutch device **58**, including the electric servo **60** and the bolt **62** may be collectively referred to herein as a "latch" or "latch assembly."

In the present example, the casing **56** may be an integral part of the shuttle assembly **46** (i.e., one-piece), and thus axially translates with the shuttle assembly **46**. The nut **50**, the bearings **52**, and the spring **54** may be mounted to the screw **44** inside the casing **56**. The nut **50** is threaded to the screw **44** such that rotation of the screw **44** about centerline **59** causes the casing **56** and shuttle assembly **46** to axially translate along the screw **44**. A first bearing **52** may be axially located between a first spring **54** and a forward end (i.e. annular face) of the nut **50**. A second bearing **52** may be axially located between a second spring **54** and a rearward end of the nut **50**.

In operation and when the steering column assembly **20** is in the powered state and the clutch device **58** is engaged, the forward and rearward bearings **52** minimize any friction produced between the springs **54** and the respective ends of the nut. The axial forces produced by the torque placed upon the screw **44** by the electric motor **48** when in the powered state are not sufficient to overcome the compressive force of the springs **54** (i.e., the springs do not compress axially).

When the steering column assembly **20** is in the decoupled state (i.e., not powered by the electric motor **48**, the clutch device **58** is not engaged (i.e., the servo **60** is de-energized). A manual axial force produced by the driver to axially extend and or retract the steering column assembly **20** may cause the nut **50** to free-wheel (i.e., back spin) upon the, now stationary, screw **44** enabling the shuttle assembly **46** to axially translate.

Referring now to FIG. **4**, three discrete zones—or regions—associated with positioning of the steering column assembly **20** are illustrated. The embodiments described herein provide a system and method that automatically latches and unlatches the clutch device **58** in a power column during an ADAS event. As will be appreciated from the disclosure, this eliminates the need for the driver to wait until the column unstows from the stow position and it will provide the capability to restrict driver intervention during a stow operation.

A first region may be referred to as an unstowed region and is generally referenced with numeral **100**. The first region **100** defines boundaries of the telescope and rake positions where the driver may have full control of adjustability of the steering column assembly **20**. In other words, the driver has full control of telescope and/or rake adjustment when the steering column assembly **20** is in the first region **100**. Reference to the steering column assembly **20** being within the first region **100** refers to a specified portion or location of the steering column assembly **20** being within the first region **100**. For example, the most rearward portion of the overall assembly, such as the steering input device (e.g., steering wheel) may be the reference point of the overall assembly that defines when the steering column assembly **20** is considered to be in the first region **100**. However, alternative reference points of the steering column assembly **20** may be employed in some embodiments.

A second region may be referred to as a transitional region and is generally referenced with numeral **110**. The second region **110** defines boundaries of the telescope and rake positions where the driver cannot manually move the steering column assembly **20** towards the instrument cluster (i.e., forward in vehicle). In other words, the driver has partial control of telescope and/or rake adjustment when the steering column assembly **20** is in the second region **110**, since s/he may only adjust the steering column assembly **20** rearwardly away from the instrument cluster. Reference to the steering column assembly **20** being within the second region **110** refers to a specified portion or location of the steering column assembly **20** being within the second region **110**. For example, the most rearward portion of the overall assembly, such as the steering input device (e.g., steering wheel) may be the reference point of the overall assembly that defines when the steering column assembly **20** is considered to be in the second region **110**. However, as with the first region description, alternative reference points of the steering column assembly **20** may be employed in some embodiments.

A third region may be referred to as a stowed region and is generally referenced with numeral **120**. The third region **120** defines boundaries of the telescope and rake positions where the driver cannot manually move the steering column assembly **20** in any direction. In other words, the driver has no control of telescope and/or rake adjustment when the steering column assembly **20** is in the third region **120**. Reference to the steering column assembly **20** being within the third region **120** refers to a specified portion or location

of the steering column assembly **20** being within the third region **120**. For example, the most rearward portion of the overall assembly, such as the steering input device (e.g., steering wheel) may be the reference point of the overall assembly that defines when the steering column assembly **20** is considered to be in the third region **120**. However, as with the first and second region descriptions, alternative reference points of the steering column assembly **20** may be employed in some embodiments.

As shown in FIG. **4**, each region **100**, **110**, **120** defines a tapering of the rake position boundary of the steering column assembly **20**. The rake position boundary is referenced with numeral **130**. Positioning and travel along the telescope path during stowing or unstowing of the steering column assembly **20**, driver restriction can be applied for safe operation and transition. The above-described restrictions, system response and/or region boundaries are configurable based on the particular application of use, thereby providing design flexibility.

The latch (FIG. **3**), i.e., clutch device **58**, is provided to control when manual extension of the steering column assembly is permitted. In particular, the nut **50** is latched in the first and second regions **100**, **110** (i.e., unstowed or transition region) so the steering column assembly can move automatically. However, if the steering column assembly is in the third region **120** (i.e., stowed), the nut **50** is unlatched to provide the driver with the option to manually pull the steering column assembly away from the stowed position for manual driving.

Referring to FIG. **5**, illustrated is a sequence of operating conditions of the steering column assembly **20**, showing a method of automatically latching and unlatching the steering column assembly **20**.

The telescope and tilt position of the steering column assembly **20** is detected at block **200**. Such detection may be made at least in part with one or more sensors or a similar detection component. The detection determines which region **100**, **110**, **120** the portion of interest of the steering column assembly (e.g., retractable portion **28**) is in at block **201**. If within the third region **120** (i.e., stowed region), the capability to manually adjust the steering column assembly in any direction is not available. Disabling of a switch or the like is shown with block **202** to illustrate the adjustment restriction. The system determines if an automated unstowing (i.e., extending) event is occurring at block **204**. If the steering column assembly **20** is not undergoing an unstowing event, the system determines if the clutch device **58** and nut **50** are unlatched at block **206**. An unlatched condition allows the driver to quickly and easily manually extend the steering column assembly to an unstowed position. If an unlatched condition is not present, unlatching occurs at block **208**.

Referring back to block **204**, if it is determined that the steering column assembly **20** is undergoing an unstowing event, the system determines if the clutch device **58** and nut **50** are latched at block **210**. If unlatched, the system commands latching to facilitate the automated unstowing action at block **211**. If latched, the automated unstowing action is performed.

Referring back to block **202**, if the steering column assembly is determined to be in the first or second region **100**, **110** (i.e., unstowed), the system determines if the clutch device **58** and nut **50** are latched at block **212**. If so, the latched state is maintained. If not, latching is commanded at block **214**.

Although the system and method described above include three discrete regions that the steering column assembly **20** is moveable within, it is to be understood that more or fewer regions may be included in some embodiments. For example, only two regions may be provided, with one region allowing full or partial manual adjustment capability for a driver, while the other region may allow no or partial manual adjustment capability. Similarly, more zones may be provided, each with different manual adjustment capability restrictions.

The embodiments described herein monitor the position of at least a portion of the steering column assembly **20**. The above-described latching and unlatching commands are performed by a latch motor and any suitable controllers and/or processing devices. To verify that the latch and unlatch commands occur, one or more of the following conditions may be utilized. For example, the system and method may determine if the current exceeds a current threshold, if a battery voltage based timer has expired, or if a Hall effect sensor indicates a latch or unlatch event.

While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description.

Having thus described the invention, it is claimed:

1. A retractable steering column assembly comprising: a retractable portion;

an electric actuator mechanism for translating and/or tilting the retractable portion; and

a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion, wherein the electric actuator mechanism translates and/or tilts the retractable portion throughout a plurality of regions, the latch in the latched condition in at least one of the plurality of regions and in the unlatched condition in at least one of the plurality of regions, wherein the plurality of regions comprises a first region and a second region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, positioning of the retractable portion in the first region requiring the latch to be in the latched condition, positioning of the retractable portion in the second region requiring the latch to be in the unlatched condition.

2. The retractable steering column assembly of claim **1**, wherein the retractable portion is an upper jacket of the steering column assembly.

3. A retractable steering column assembly comprising: a retractable portion;

an electric actuator mechanism for translating and/or tilting the retractable portion; and

a latch moveable between a latched condition and an unlatched condition, the unlatched condition allowing manual adjustment of the retractable portion, the latched condition preventing manual adjustment of the retractable portion, wherein the electric actuator mechanism translates and/or tilts the retractable portion throughout a plurality of regions, the latch in the

latched condition in at least one of the plurality of regions and in the unlatched condition in at least one of the plurality of regions, wherein the plurality of regions comprises a first region, a second region and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster, positioning of the retractable portion in the first region or the second region requiring the latch to be in the latched condition, positioning of the retractable portion in the third region requiring the latch to be in the unlatched condition.

4. The retractable steering column assembly of claim **3**, wherein the steering column assembly is in an autonomous steering mode when the retractable portion is in the third region.

5. A method of controlling adjustment of a steering column assembly comprising:

detecting a position of the steering column assembly;

determining which one of a plurality of regions the position of the steering column assembly is within;

unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions; and

latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions, wherein detecting the position comprises detecting a position of a portion of a retractable portion of the steering column assembly, wherein the plurality of regions comprises a first region, a second region, and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster, detecting whether the latch is in the latched condition while the retractable portion is in the first region and the second region.

6. The method of claim **5**, further comprising moving the latch to the latched condition while the retractable portion is in the first region and the second region if the latched condition is not detected.

7. A method of controlling adjustment of a steering column assembly comprising:

detecting a position of the steering column assembly;

determining which one of a plurality of regions the telescope position of the steering column assembly is within;

unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions; and

latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions, wherein detecting the position comprises detecting a position of a portion of a retractable portion of the steering column assembly, wherein the plurality of regions comprises a first region, a second region, and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster, wherein positioning of the retractable portion in the first region or the second region requires the latch to be in the latched condition, positioning of the retractable portion in the third region requires the latch to be in the unlatched condition.

8. A method of controlling adjustment of a steering column assembly comprising:

detecting a position of the steering column assembly;

determining which one of a plurality of regions the telescope position of the steering column assembly is within;

unlatching a latch selectively engageable with the steering column assembly to allow manual adjustment of the steering column assembly if the steering column assembly is within at least one of the plurality of regions;

latching the latch to prevent manual adjustment of the steering column assembly if the retractable portion is within at least one of the plurality of regions, wherein detecting the position comprises detecting a position of a portion of a retractable portion of the steering column assembly, wherein the plurality of regions comprises a first region, a second region, and a third region, the first region located further from an instrument cluster than the distance between the second region and the instrument cluster, the second region located further from an instrument cluster than the distance between the third region and the instrument cluster; and

determining whether the retractable portion is being automatically extended while the retractable portion is in the third region.

9. The method of claim **8**, further comprising detecting whether the latch is in the latched condition while the retractable portion is being automatically extended.

10. The method of claim **9**, further comprising moving the latch to the latched condition if the latched condition is not detected.

11. The method of claim **8**, further comprising detecting whether the latch is in the unlatched condition while the retractable portion is not being automatically extended.

12. The method of claim **11**, further comprising moving the latch to the unlatched condition if the unlatched condition is not detected.

* * * * *